MASTER OF SCIENCE
IN
INFORMATION TECHNOLOGY MANAGEMENT

IMPLEMENTATION CONSIDERATION FOR WINDOWS NT INTEGRATED NETWORK FOR SYSTEM MANAGEMENT COMPUTER LABORATORIES

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The integrated token ring LAN of the Systems Management Department of the Naval Postgraduate School is progressively moving its network platform from Microsoft Windows for Workgroups to Windows 95 Client and Windows NT Server to improve LAN performance and to meet an increasing demand from students and the faculty for the latest software applications.

This thesis is a study of configuration for the installation of Windows NT Server 3.51. An incremental installation concept is implemented throughout the installation of Windows for Workgroups, Windows 95 and applications software. Logical client-server connection has been partially implemented and tested successfully using a client running under Windows for Workgroups and client running under Windows 95 to access application on the Windows NT Server 3.51. For a sample test, the SMERFS, an MS-DOS-based application, is used in these experiments because the SMERFS is a relatively small program and does not take a long time to be accessed.

The recommendations presented include suggestions for the upgrade of the integrated token ring LAN to a Windows NT Server 3.51 with Clients using Windows 95.

THE CHARACTERISTICS OF SUCCESSFUL MARINE CORPS RECRUITING STATIONS: LEADERSHIP AND INFORMATION SHARING

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Marine Corps recruiting duty is the toughest peacetime assignment for any Marine. It involves complex internal and external factors dealing with global, national, and local issues completely out of the control of recruiting personnel, making it a truly dynamic duty. Furthermore, recruiting is an assignment where performance is based largely on quantitative measures. Marines, at all levels, are under immense pressure to make assigned recruiting goals or be relieved from duty. The objective of this thesis is to describe the characteristics of the successful recruiting stations and define how they could reengineer through information technology. Using appreciative inquiry at the most successful recruiting stations, recruiters, noncommissioned officers in charge, and command group members are interviewed to discover and understand the factors that give life to their stations. The culture of these stations is then characterized to illustrate how they confront pressures to meet assigned goals. The outcome is that successful recruiting stations are designed for high performance and represent prime candidates to implement reengineering. Redesign through information technology offers to reduce the organizational complexity within recruiting stations thereby limiting pathologies and increasing efficiency. Recommendations are offered for further research.

IMPLEMENTING A LAN THAT INTERFACES WITH THE DMS AND USES MISSI

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The Defense Message System (DMS) is being implemented throughout the Department of Defense and will replace AUTODIN for individual and organization messages by the year 2000. The Naval Security Group Detachment, Monterey

and any other command that sends or receives organizational or individual messages must be ready to implement DMS on their Local Area Network. This thesis fully describes the Defense Messaging System standards and components and details what needs to be implemented in a Local Area Network in order to be prepared for the initial operating capability of the DMS, scheduled for July, 1996.

EVALUATING KNOWLEDGE BASED SOFTWARE DEVELOPMENT TOOLS

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Empirically evaluating software development tools to investigate their strengths and weaknesses as used in the DoD is not easy or commonplace today. Empirical evaluations are especially important while introducing new technologies such as the knowledge based software development tools, which aim at significantly improving the software development process and productivity. This study investigates a variety of methods used to evaluate new software development tools and gives recommendations on how to proceed using the following four methods: (1) case study, (2) survey, (3) formal experiment, and (4) benchmark inspection. A usability evaluation of a tool is conducted to highlight various aspects of a rigorous evaluation. Conclusions drawn from this evaluation show the importance in selecting an appropriate sample group as well as the effort required to achieve a rigorous evaluation. Indications/Recommendations for conducting rigorous evaluation of knowledge based software development tools are provided. Evaluating a new software technology after it has already been introduced to an organization is an indication to consider using a field survey, whereas evaluating two or more technologies as a basis for selection is an indication to use formal experiment in collecting data. Recommendations such as: using a control group, pre- and post-testing groups, and using video capture help to assure causality threats are mitigated.

PRICING INFORMATION SERVICES IN ELECTRONIC MARKETS: CASE STUDY OF DECISIONNET

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The Internet has experienced rapid growth since its beginning as a government-funded communications network. This growth has partially contributed to the explosion of commerce on the net. One example of services offered on the Internet is DecisionNet. It provides an electronic environment of decision support and modeling technologies. The purpose of this thesis is to design an equitable pricing scheme for those on-line information service providers. DecisionNet is used as a case study to describe the pricing policies.

Service pricing over the Internet is still in its infancy. As a result there is not one set model for pricing Internet services that can directly be applied to applications such as DecisionNet. The pricing strategy should be based both on pricing theory and industry practices (pertaining to services). This thesis has taken this approach. Research was also conducted on the United States Government's acquisition process. This was necessary because the government is expected to be a major consumer of on-line information services.

This thesis has proposed a simple yet effective pricing policy which is designed to recoup both the fixed and the variable costs associated with providing information services over the Internet. The policy is based on the strategy of market segmentation. The segments have been broken into four areas and further subdivided based on numbers of users and level of usage. Suggestions have also been made in regards to how to recoup both the fixed costs and the variable costs.

REENGINEERING DOD THROUGH ENTERPRISE-WIDE MIGRATION TO OPEN SYSTEMS

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The Department of Defense cannot afford to develop and deploy information systems that have no growth potential. Legacy systems must be replaced with flexible, highly interoperable systems that produce high residual values. With shrinking budgets, depreciation of exiting hardware, and rising maintenance of legacy systems, organizations must deploy systems that are capable of evolving with changing business requirements.

The Department of Defense enterprise vision for information management (IM) emphasizes integration, interoperability, flexibility, and efficiency through the development of a common, multi-purpose, standards-based technical infrastructure. This vision requires a new paradigm for building information systems.

The new paradigm relies on open systems, which make it easier, less expensive, and faster to develop and change applications and to employ new technology features. This research examines open systems and provides a strategy for organizations to migrate to them. A case study of the Naval Postgraduate School illustrates the strategy. Provisionally, a prototype application models the desired characteristics of an open system.

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Kenneth G. Carrick-Captain United States Army
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INFRASTRUCTURE CONSIDERATIONS FOR WORLD WIDE WEB SERVERS

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This thesis explores issues associated with defining and selecting infrastructure requirements for World Wide Web sites. The explosive growth of the WWW has made it the largest single service on the Internet. With this growth comes a need for guidance to organizations or individuals desiring to establish new Web sites. This thesis provides the guidance needed to define a potential site's requirements and select the infrastructure necessary to fulfill those requirements.

A combination of literature review of current books and periodical, as well as surveys of WWW sites was used to obtain information. This information was used to develop the framework for defining requirements. A rule based heuristic was also adopted from the literature and subsequently validated. It is used to select the computing hardware needed for a site.

A key lesson learned is that most organizations do not conduct initial requirements analysis to determine a site's infrastructure needs. The reasons range from oversight to indifference. The potential penalty for not conducting proper assessment of requirements is the same as for any venture, a substandard product and poorly leveraged investment.

DEVELOPMENT AND IMPLEMENTATION OF AN INFORMATION SYSTEM FOR THE NAVAL POSTGRADUATE SCHOOL INTERNATIONAL PROGRAMS OFFICE

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The Naval Postgraduate School (NPS) International Programs Office's (IPO) mission requires timely, accurate, and intensive information exchange with the outside military and civilian agencies to accomplish the goals of the Security Assistance and the Information Programs. Therefore its information infrastructure is becoming a vital key to the organization's success or failure in performing its mission-critical tasks. Currently the office achieves its goals to a great extent without taking advantage of an information system to support its administrative activities more efficiently.

This thesis conducts a thorough analysis and documentation of the information requirements of the Naval Postgraduate School International Programs Office. Based on the requirements identified, the thesis develops and implements a series of functional computer applications which supports the NPS IPO administrative activities.

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

DESIGN AND IMPLEMENTATION OF A WORLD WIDE WEB CONFERENCE INFORMATION SYSTEM

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The Asilomar Conference on Signals, Systems and Computers is a technical conference dealing in signal and image processing, communications, sensor systems, and computer hardware and software. Sponsored by the Naval Postgraduate School and San Jose State University, in cooperation with the IEEE Signal Processing Society, the conference is held annually at the Asilomar Conference Facility in Pacific Grove, California. Although the Asilomar Conference is oriented toward computers and new technology, it has yet to exploit the full capabilities of the Internet.

The purpose of this thesis is to: a) Analyze the processes involved in the Asilomar Conference on Signals, Systems, and Computers, b) Improve the article submission and review process, c) Outline a target information system, and d) Implement a portion of the target system.

Two major portions of the target system are implemented using an IBM compatible PC: 1) the ability for authors to submit abstracts and summaries via the Internet, and 2) to allow conference administrators to manage the database via the Internet. Dynamic World Wide Web pages are created using Borland Delphi as the programming base, O'Rielly's WebSite as the web server, and two Common Gateway Interface elements for Delphi recently developed by Ann Lynnworth of HREF Tools Corp. The portions implemented lay the foundation for a system that could revolutionize the way conferences are conducted by unleashing the power of the Internet.

THE SOCIOTECHNICAL DYNAMICS OF A TRAVEL MANAGEMENT REENGINEERING PROJECT

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James Emery, Department of Systems Management

This thesis examines the travel management reengineering project of one DoD command. It analyzes the process selection, redesign, and implementation of the travel project and discusses the managerial implications of the project.

A review of process innovation, reengineering, and planned-change literature provides a framework for exploring the activities of the reengineering team, but semi-structured interviews and personal observations of project participants were the major source of data for the analysis.

The analysis is completed with a comprehensive look at lessons learned from the project. The research concludes that the travel management project required senior management participation and guidance, the active involvement of all project team members, and an appreciation for the natural reactions of the intended users of the new process.

AN FDDI-BASED SOLUTION FOR THE SYSTEMS MANAGEMENT DEPARTMENT COMPUTER LABORATORY NETWORK

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FDDI is one of the latest evolutions in shared-media technology. Originally intended as a high-speed backbone for interconnecting networks, it has become a viable alternative for organizations that seek better response time and bandwidth capacity from their local area networks (LANs). However, this fiber-based standard is an expensive departure from the more familiar, and perhaps more mature, IEEE 802 token-ring and Ethernet standards. Thus, developing an FDDI-based network may present considerable economic and technical risk to an organization.

This study examines the application of FDDI technology as an upgrade to the Systems Management Department's token-ring network. It reviews the protocols that comprise the standard, addresses design considerations for developing an FDDI network, evaluates the existing token-ring LAN, and proposes an FDDI solution. This study concludes that the risks of implementing an FDDI-based upgrade, can be mitigated using an evolutionary design strategy.

DESIGN AND IMPLEMENTATION OF A WORLD WIDE WEB CONFERENCE INFORMATION SYSTEM

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MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

TECHNOLOGY TRANSFER OF THE COMPUTER-AIDED PROTOTYPING SYSTEM (CAPS)

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The inability of the Department of Defense (DoD) to accurately and completely specify requirements for hard real-time software systems has resulted in poor productivity, schedule overruns, and software that is unmaintainable and unreliable. The Computer-Aided Prototyping System (CAPS) provides a capability to quickly develop functional prototypes to verify feasibility of system requirements early in the software development process. It was built to help program managers and software engineers rapidly construct software prototypes of proposed software systems. CAPS was developed by the Software Engineering Group at the Naval Postgraduate School (NPS) in Monterey, California.

This thesis investigates the transfer of technology of CAPS from NPS to DoD and the commercial industry. The effective transfer of technology requires user awareness of the technology and the ability to utilize the technology. Thus, a strategy is prepared for implementing the technology transfer of CAPS at NPS. To aid in this implementation, the quality and effectiveness of existing CAPS technical documentation is evaluated and recommendations for enhancement provided. Information dissemination materials are developed as part of this thesis which include three levels of CAPS briefings to potential sponsors, a home page, and a CD-ROM multimedia presentation. The implementation of this strategy will not only maximize the transfer of technology to the users, but also provide the optimum use of DoD software engineering resources available.

OVERHEAD NON-IMAGING INFRA-RED (ONIR) SENSOR-TO-SHOOTER CONNECTIVITY OPTIONS FOR THEATER-WIDE BALLISTIC MISSILE DEFENSE AND PRE-APOGEE INTERCEPT FROM THE SEA

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This thesis studies dissemination of Overhead Non-Imaging Infra-Red (ONIR) Defense Support Program (DSP) and National System infra-red (IR) event and track data to tactical users. The study is motivated by a requirement to improve the lethality of Aegis class ships performing in a joint theater-wide ballistic missile defense (TBMD) role. The dissemination of IR data is considered within the context of the entire Theater Event System (TES) architecture and the combat system detect-control-engage TBMD cycle (expanded to sensor-processing-dissemination-weapons systems). Options that will improve the timely receipt of missile warning messages are reviewed. Potential future modifications to the TES architecture are examined in terms of their ability to pass IR missile warning messages to the tactical user within theater-wide missile defense requirements. Options reviewed include (1) early detect reporting, (2) tactical processing improvements, (3) Joint Tactical Ground Station (JTAGS) Remote (JTAGS-R), and (4) JTAGS Navy (JTAGS-N). A Measure of Performance (MOP) Baseline Standard is derived and the options presented are examined and evaluated against this MOP. Finally, based on this information feasibility analysis, a recommendation is made regarding future decisions and requirements for a sea-based theater-wide missile defense information architecture.

INTERNETWORKING: NPS ATM LAN

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The objective of this research is to create, build, and test an electronic information infrastructure at NPS based on ATM cell relay, and to lay the groundwork for future ATM work at NPS.

One aspect of this research is to critique ATM as a future networking technology for DoD and the U.S. Navy. This research demonstrates five fatal flaws of ATM with respect to the military environment. First, there is the interoperability between switches. There is no way to guarantee communication between switches. Second, there is ATM's incompatibility with IP. There is no native way to multicast with ATM. Overcoming the multicasting problem is probably the greatest ATM problem to solve, and on-going research has yet to find a native ATM solution to this problem. Third, there is ATM's inflexibility to change. Myriad long-haul problems exist. Fourth, there is the human factor. The "expertise" that exists in the ATM field is nominal due to the immaturity of the technology. Fifth, there is the crossover problem. The crossover system from primary to backup mechanisms must be reliable. ATM has not solved the problem of crossover. If a connection is broken, there is no standby connection waiting to immediately take over; and this scenario is exacerbated in the already problematic multicast situation. Before DoD becomes too committed to ATM, these five issues need to be explicitly and fully resolved.

INTERNETWORKING: INTEGRATING IP/ATM LAN/WAN SECURITY

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Computer and network security is a complex problem and one that is not solely restricted to classified computer systems and networks. Accelerating trends in networking and the emphasis on open and interoperable networks has left many unclassified systems vulnerable to a wide variety of attacks. Computer and network professionals must understand the scope of security, recognize the need for security for even unclassified systems and then take steps to protect their systems.

Transmission of static passwords in plaintext over the Internet is one of the most widely publicized network vulnerabilities. One-time password mechanisms (such as S-Key) or other secure network access mechanisms (such as Kerberos) have been recommended to improve access security for computer systems connected to the Internet.

This thesis examines many of the issues that must be addressed when assessing the need for computer and network security. This work provides the results of a site security survey for the unclassified IP/ATM LAN in the Systems Technology Lab at the Naval Postgraduate School. These results highlight new security vulnerabilities and strengths that occur when standard Internet Protocol (IP) local-area networks (LANs) are internetworked with Asynchronous Transfer Mode (ATM) wide-area networks (WANs). Finally, we examine the feasibility of the Kerberos authentication protocol for remote plaintext password protection and provide recommendations for additional work.

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

DECISIONNET: A DATABASE APPROACH

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This thesis describes the database design and implementation for DecisionNet — a distributed decision support technology server for the World Wide Web. The main premise of DecisionNet is that decision support technologies can be utilized by consumers as services over the World Wide Web instead of being purchased as stand-alone products. In this sense, DecisionNet performs the role of an "agent," facilitating transactions between consumers and providers.

All of DecisionNet's functions involve some form of data lookup and modification, as well as common fields of data for similar classes of entities. As such, a database approach seems appropriate for DecisionNet. With this approach, the interaction of database queries with scripting languages can facilitate remote execution of decision support software.

The DecisionNet prototype developed as a result of this research involves the use of a relational database that is directly accessed via Common Gateway Interface (CGI*)* scripts. These CGI scripts are invoked by users with a simple web browser. This thesis contains a description of "agent" models for transactions, the relational database design, a description of all CGI scripts, and development of a user interface for the system.

ELECTRONIC COMMERCE: AN ANALYSIS OF FINANCIAL TRANSACTION METHODS AND ASSOCIATED SECURITY

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Barry A. Frew, Department of Systems Management

This study examines an obstacle to commerce on the Internet and the World Wide Web posed by a popular belief that the Internet and Web lack the technology needed for secure financial transactions. The reality behind such a belief has a direct effect upon commercial and financial transactions by DoD in view of an Executive Order that mandates Internet usage for electronic transactions. This study details and evaluates the methods available for secure financial transactions on the Internet. Each transaction method analysis provides security protocol functionalities, advantages and disadvantages and company profiles. The study also details the impediments to using the World Wide Web as a commercial medium. It concludes that the popular belief is unfounded. Implications are drawn for DoD practices and policy. DoD and the entire U.S. federal government has a stake in the Internet's capability to process secure financial transactions.

INFORMATION SYSTEMS SECURITY REQUIREMENTS FOR THE ENGINEERING 2000 INITIATIVE OF THE TOMAHAWK ENGINEERING COMMUNITY

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The Tomahawk Engineering community's *Engineering 2000 Initiative*, sponsored by the Cruise Weapons Department at the Port Hueneme Division of the Naval Surface Warfare Center (NSWC-PHD), integrates engineering, logistics and management tools into a single desktop computer. This integration creates problems in providing suitable Information Systems Security (ISS). This thesis addresses ISS and suggests areas that require management attention. The thesis includes a discussion of ISS issues, policies, and initiatives, a development of the ISS Management Model and a methodology for its use; an application of the Model methodology in the assessment of the *Baseline ISS Management State*; and an application of the Model's methodology in the development of the *Target ISS Management State*. The difference between the *Target ISS Management State* and *Baseline ISS Management State* produces a list of ISS recommendations to bridge the gap between the states. Some of these recommendations include: restructuring NSWC-PHD's ISS organization, increasing user awareness, centralizing user accountability to the ISS staff, and increasing management commitment to NSWC-PHD's ISS policies.

DATA MINING USING NEURAL NETWORKS

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The Department of Defense maintains a number of large databases. Recent studies have shown that only a small fraction of such large databases are ever analyzed. These databases present a potential goldmine of valuable information to military planners and commanders. Through the use of powerful Data Mining tools, such as Neural Networks, researchers hope to extract implicit, previously unknown and potentially useful information. This thesis uses an advanced software modeling tool to create a neural network to explore the reasons why career-eligible Marines choose to stay in the Marine Corps. The data set used in this research is from the Headquarters Marine Corps Enlisted Master File from fiscal year 1993. During that period, Marines were offered voluntary separation incentives to help shape the career force during the recent military service downsizing. The network is presented with 37 input variables that include information on a Marine's education, military specialty, and current assignment among other data fields. Many Marines eligible for these separation incentives decided to stay in the Marine Corps. The neural network model results reinforce the importance of physical fitness in the Marine Corps culture and as a career retention factor. Several intangible factors are also highlighted by the network as important factors for Marines to remain in the service. These results may be used by military planners to continue to shape the armed forces manpower pool.

THE SOCIOTECHNICAL DYNAMICS OF A TRAVEL MANAGEMENT REENGINEERING PROJECT

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This thesis examines the travel management reengineering project of one DoD command. It analyzes the process selection, redesign, and implementation of the travel project and discusses the managerial implications of the project's dynamics.

A review of process innovation, reengineering, and planned-change literature provides a framework for exploring the activities of the reengineering team, but semi-structured interviews and personal observations of project participants were the major source of data for the analysis.

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This thesis studies dissemination of Overhead Non-Imaging Infra-Red (ONIR) Defense Support Program (DSP) and National System infra-red (IR) event and track data to tactical users. The study is motivated by a requirement to improve the lethality of Aegis class ships performing in a joint theater-wide ballistic missile defense (TBMD) role. The dissemination of IR data is considered within the context of the entire Theater Event System (TES) architecture and the combat system detect-control-engage TBMD cycle (expanded to sensor-processing-dissemination-weapons systems). Options that will improve the timely receipt of missile warning messages are reviewed. Potential future modifications to the TES architecture are examined in terms of their ability to pass IR missile warning messages to the tactical user within theater-wide missile defense requirements. Options reviewed include (1) early detect reporting, (2) tactical processing improvements, (3) Joint Tactical Ground Station (JTAGS) Remote(JTAGS-R) and (4) JTAGS Navy (JTAGS-N). A Measure of Performance (MOP) Baseline Standard is derived and the options presented are examined and evaluated against this MOP. Finally, based on this information feasibility analysis, a recommendation is made regarding future decisions and requirements for a sea-based theater-wide missile defense information architecture.

AN ANALYSIS OF FUTURE CAPACITY REQUIREMENTS FOR THE U.S. ARMY'S TACTICAL PACKET NETWORK

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This thesis examines the U.S. Army's infrastructure for data communication in a tactical environment, in light of anticipated requirements. The first part of the study covers the nature of this problem; it is a technology forecast for an infrastructure project. This is used as a foundation for the discussion of the Army's approach to determining its future acquisition plan in Chapter III. Chapter IV considers the future use of the network in terms of the types of application programs that are likely to run over the network. Chapter V then considers the communications capacity that will be required simply to establish and operate the network itself. The conclusions are summarized in Chapter VI.

The conclusion of this study is that the optimum future network capacity will greatly exceed the level that would be predicted by extrapolating from currently identified uses. This future level of demand will need to be supported by the network infrastructure, which requires a long lead time and large capital investment to put in place. Because future demand for digital communications will grow so rapidly, an aggressive approach to determining the future network capacity requirement is recommended. In the next ten year period, any capacity available will likely be utilized rapidly resulting in desirable operational and cost saving benefits. Therefore, future capacity should be determined to a large degree by the maximum that it is technically and economically feasible to provide.

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

LEATHERNET: AN EVALUATION AS A MISSION PLANNING AND BRIEFING TOOL

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The author evaluates LeatherNet, a Distributed Interactive Simulation compliant, virtual simulation system being developed by the Advanced Research Projects Agency to demonstrate Modeling and Simulation (M&S) technologies and to partially fulfill the U.S. Marine Corps M&S goals. The research focuses on evaluation of LeatherNet as a mission planning and briefing tool for Marine infantry company commanders, staff, and subordinate leaders. Evaluation is based on user perception and user performance on a live fire range subsequent to using the system. The user surveys indicate high user acceptance and belief that LeatherNet is a valuable mission planning and briefing tool and that LeatherNet has a good potential to be an effective training tool for commanders and their staffs. User performance, evaluated by subject matter experts on a live fire range, showed no statistically significant improvement for groups exposed to LeatherNet when compared to groups that did not use LeatherNet. The author explains why true differences, even if they do exist, would be difficult to detect due to the lack of experimental control and recommends action to be taken by the Marine Corps to conduct further testing with greater experimental control. The author also suggests steps the Marine Corps can take to optimize its investment in M&S.

RADIANT MERCURY: AN ASSESSMENT OF THE ISSUES

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The Department of Defense (DoD) has a need to disseminate classified information in a controlled manner. Often classified information must be filtered and/or sanitized prior to its release to particular entities. Sensitive information can be particularly vulnerable to human error in release decisions when a high volume of information is involved. Radiant Mercury (RM) is a system designed to alleviate some of the problems associated with such scenarios. By discussing the automated dissemination of classified information with appropriate DoD agencies as well as obtaining briefings from the developers of RM, an analysis of the system was possible. Topics discussed in this thesis include: 1) the adequacy of assurance provided by a Class B1 evaluated system, 2) the intricacy and content/context sensitivity of the RM rules, 3) the near term obsolescence of the RM evaluated hardware platform, 4) the impact of rules modification on system accreditation, and 5) the need for training of RM users. Overall, Radiant Mercury provides an automated system for filtering and disseminating information that may be useful where high message throughput is needed.

A SOFTWARE RELIABILITY ENGINEERING CASE STUDY

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Handling, identifying, and correcting faults are significant concerns for the software manager because (1) the presence of faults in the operational software can put human life and mission success at risk in a safety critical application and (2) the entire software reliability process is expensive. Designing an effective Software Reliability Engineering (SRE) process is one method to increase reliability and reduce costs. This thesis describes a process that is being implemented at Marine Corps Tactical Systems Support Activity (MCTSSA), using the Schneidewind Reliability Model and the SRE process described in the American Institute of Aeronautics and Astronautics Recommended Practice in Software

Reliability. In addition to applying the SRE process to single node systems, its applicability to multi-node LAN-based distributed systems is explored. Each of the SRE steps is discussed, with practical examples provided, as they would apply to a testing facility. Special attention is directed to data collection methodologies and the application of model results. In addition, a handbook and training plan are provided for use by MCTSSA during the transition to the SRE process.

ANALYSIS AND DESIGN OF AN INFORMATION SYSTEMS NETWORK IN THE FORMER SOVIET UNION
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In an effort to facilitate democratic reforms in the Former Soviet Union (FSU), the President of the United States authorized the establishment of American Business Centers (ABCs) through the Freedom Support Act of 1992. The Act promotes U.S. economic interests by establishing commercial partnerships between the United States and the FSU. Integral to this transition is the role of information technology. The purpose of this thesis is to assist the ABCs in defining their information system needs by producing a network model that takes into account the unique operating environment within the FSU. The essential elements of this model are range, reach, and responsiveness. They characterize the utility of an information system to an organization. The model is applied to the ABCs to form a baseline assessment that provides a point of reference from which a target architecture can be formulated. It is this target architecture that is intended to serve as a baseline configuration for local/wide area enterprise networks to be used by the ABCs within the FSU. The thesis concludes with a discussion of those drivers that could significantly affect the viability of the American Business Centers.

CAUSALITY TRACING USER INTERFACE DESIGN AND DEVELOPMENT FOR A SOFTWARE MANAGEMENT FLIGHT SIMULATOR
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Interactive simulations are a highly suitable tool for training managers in their increasingly complex roles in software project management. This research effort designs and implements an interactive user-friendly interface for the system dynamics software development and project management model using a flight simulator as a metaphor. Methods and techniques for good user interface development are considered and implemented using the Ventana Simulation (Vensim) application development, modeling, and analysis environment. The resulting interface facilitates the user experimentation with management policy strategies and decision making, as well as the investigation of scenarios to determine what the circumstances were that caused the project's expected behavior to vary. The analysis capabilities of the interlace enables the user to trace cause and effect relationships that are often invisible and not considered when making management decisions. The interface's causal tracing functionality significantly enhances the value of the underlying model as a learning tool by facilitating the development of an integrated, improved vision of the world that managers are responsible to control.

EVOLUTIONARY DESIGN OF LOCAL AREA NETWORKS

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This study presents the evolutionary design of a local area network. In the last few years network managers have been faced with rapidly advancing technology and increased demand on LAN bandwidth from users. The purpose of this study is to assist network managers in decision making when developing a mid-size LAN.

The methodology for this study is to develop a mid-size LAN using current technology to replace a router-based design with a switch-centric design. As an example, the current proposal for the Republic of China's military school's campus network is used as a basis for redesigning a LAN by taking advantage of the emerging switch technology. This switch-centric design is evolved from a revised basic model to an enhanced and advanced model.

The resultant design arrived at is less expensive, easier to manage, and simpler than the current router-based design and allows greater flexibility to meet users' increasing bandwidth demands. The fundamental advantages of switching technology over router-based solutions is a lower per port cost, higher capacity and faster response.

USING GENETIC ALGORITHMS TO SEARCH LARGE, UNSTRUCTURED DATABASES: THE SEARCH FOR DESERT STORM SYNDROME

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The Exploratory data analysis problems have recently grown in importance due to the large magnitudes of data being collected by everything from satellites to supermarket scanners. This so-called "data glut" often precludes the effective processing of information for decision-making. These problems can be seen as search problems over massive unstructured spaces. A prototypical problem of this type involves the search, by Department of Defense medical agencies, for a so-called "Desert Storm Syndrome" which involves large amounts of medical data obtained over several years following the Persian Gulf conflict. This data ranges over more than 170 attributes, making the search problem over the attribute space a hard one. We propose the use of genetic algorithms for the attribute search problem, and intertwine it with search algorithms at the detailed data level. Computational results so far strongly suggest that our system has succeeded at the given tasks, requiring relatively few resources. They also have found no indication that a single syndrome or other medical entity is responsible for wide-spread adverse health ramifications among a significant cross-section of Persian Gulf War participants in the CCEP program. There are, however, numerous correlations of exposure/demographic information and associated symptoms/ diagnoses which suggest that smaller groups may share common health conditions based on shared exposure to common health risk factors.

THINKING STRATEGICALLY ABOUT INFORMATION-BASED CONFLICT: DEVELOPING AN ANALYTICAL APPROACH TO OPERATIONAL MEASURES OF EFFECTIVENESS

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John Arquilla, Information Warfare Academic GroupMilitary measures of effectiveness (MOEs) are fundamental in determining the relative contribution of a weapon system or course of action to a campaign's objectives. This thesis examines the development of Information-Based Conflict (IBC) measures of effectiveness (MOEs) at the operational

level of war—an area that has received little attention. First, IBC is explored in terms of the strategic implications this new warfare area holds for future warfighting, including an investigation of whether IBC represents a military innovation or revolution, possible end-states to which IBC could contribute, and an evolution of IBC strategic thought. Then, the problems inherent to MOEs are illustrated with historical examples and some qualitative metrics are outlined across each level of war. Next, three specific IBC programs are examined in-depth for their approach to MOEs. Against this backdrop, an analytical approach is proposed for further IBC MOE development. Using Kiviat diagrams, this approach allows IBC MOEs to be visually represented so that the multi-dimensional, subjective, quantitative and qualitative characteristics of IBC are accommodated. In the end, this analytical approach promises to provide a new tool by which to assess the operational effectiveness of IBC.

DESIGN AND IMPLEMENTATION OF CADET CORPS (CADCORPS): A MULTIMEDIA DBMS APPLICATION FOR PERSONNEL AND TRAINING
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This thesis develops a prototype Multimedia Relational Database Management System application entitled CADCORPS. CADCORPS will be used by the Monterey County Division of the Naval Sea Cadet Corps and the Navy League Cadet Corps. A rapid prototyping approach in concert with a four phase development process is used to develop the prototype. The first chapter of the thesis provides introductory information on the purpose, scope, and methodology of the thesis. Chapter two addresses the definition and requirements phases. The design phase is addressed in chapter three. Chapter four discusses the implementation phase in conjunction with hardware, software, system programming, testing, security, and maintenance. Chapter five gives the fundamentals of incorporating Multimedia data such as sound and graphics into the prototype. The conclusion gives the advantages of using CADCORPS and provides recommendations for future improvements to the prototype.

ANALYSIS AND DESIGN OF A SPECTROMETRIC INTERFACE SYSTEM FOR THE JOINT OIL ANALYSIS PROGRAM TECHNICAL SUPPORT CENTER, PENSACOLA, FLORIDA
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This thesis addresses the analysis and design of a prototype relational database management system for oil analysis entitled, JOAP Spectrometric Interface System. A rapid prototype approach was used in concert with the four phases of the system development life cycle. The database application will be used to conduct spectrometric analysis and physical property testing on used oil samples from selected equipment. The information will be stored in a centralized database for historical purposes to determine if there is a problem with the manufacture of parts and engines, and look for potential problems that could affect the safety and performance of equipment. The spectrometric interface application will greatly assist the Joint Oil Analysis Program (JOAP) increase effectiveness, readiness, and economy of equipment.

EXECUTIVE MANAGEMENT EDUCATION TRACKING SYSTEM (EMETRAK) DESIGN AND IMPLEMENTATION ISSUES

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The Executive Management Education Program is the Department of the Navy's competency-based educational program for senior health care executives. It is designed to prepare Navy Medical Department officers for the challenges of managing modern military health care programs. This research effort analyzes the requirements of an information system to support the Executive Management Education Program. The systems development life cycle is used as a project management tool to guide system development. A requirements study is conducted to determine the information needs of the various customers. Process, data, and network models are used to describe system requirements. A prototype single-user system is implemented using Microsoft Access 2.0 and an architecture for a multi-user client server database application is proposed.

INFORMATION SYSTEMS SECURITY REQUIREMENTS FOR THE ENGINEERING 2000 INITIATIVE OF THE TOMAHAWK ENGINEERING COMMUNITY

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The Tomahawk Engineering community's *Engineering 2000 Initiative*, sponsored by the Cruise Weapons Department at the Port Hueneme Division of the Naval Surface Warfare Center (NSWC-PHD), integrates engineering, logistics and management tools into a single desktop computer. This integration creates problems in providing suitable Information Systems Security (ISS). This thesis addresses ISS and suggests areas that require management attention. The thesis includes a discussion of ISS issues, policies, and initiatives, a development of the ISS Management Model and a methodology for its use; an application of the Model methodology in the assessment of the *Baseline ISS Management State*; and an application of the Model's methodology in the development of the *Target ISS Management State*. The difference between the *Target ISS Management State* and *Baseline ISS Management State* produces a list of ISS recommendations to bridge the gap between the states. Some of these recommendations include: restructuring NSWC-PHD's ISS organization, increasing user awareness, centralizing user accountability to the ISS staff, and increasing management commitment to NSWC-PHD's ISS policies.

REENGINEERING A COMPUTER-BASED TRAINER FOR A HELICOPTER NIGHT VISION SYSTEM

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While there have been unfavorable responses to Department of Defense "right-sizing" efforts, this force restructuring has actually produced certain positive results. Capitalizing on technological advances, the aviation community, in particular, has adapted to personnel cuts and reduced budgets without sacrificing the quality of training. As a result, considerable emphasis is currently placed on computer-based training (CBT) applications. The development of this type of training for critical, high-risk, missions, such as those involving scarce night vision equipment, has encouraged numerous research projects including this thesis.

Sponsored by Naval Air Systems Command (PMA-205), this thesis discusses methods used to re-engineer the UH-1N helicopter Aviator's Night Vision Imaging System/Heads-Up Display (ANVIS/HUD) CBT for use in the HM-60H community. By using portions of code, graphics, and text originally designed for the UH-IN CBT, the HH-60H version was developed through a revision process which incorporated new material as required.

The final product is a trainer consisting of five instructional modules, combining student evaluation and remediation features through interactive lessons and exercises. In accordance with current design principles, an object-oriented authoring system enabled the production of a quality CBT that meets the sponsor's budget and time constraints, and promises to be a key training asset for HH-60H personnel.

INTRANETS

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The purpose of this thesis is to develop a prototype Client-Server application that can be used by selected Naval Postgraduate School staff-members to coordinate meeting agendas and travel plans. A prototype application that can be implemented and deployed on an organizational network was designed and developed using commercially available tools. The thesis also addresses the current computing problems confronting this institution and the reasons why corporate America is embracing Web-based intranet technology; it will also examine why a Web-based intranet is a viable solution for many of the computing problems facing this organization. Additionally, we examined other applications that can be developed and deployed on an intranet at the Naval Postgraduate School. Finally, we explore the renowned intranet at Sandia National laboratories and explain which factors played the most significant role in the success they have achieved with intranet technology at their organization.

PROMOTING DISTANCE EDUCATION AT NAVAL POSTGRADUATE SCHOOL (NPS)

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This thesis defines and supports five recommendations for Naval Postgraduate School (NPS) to promote its distance education program. The research and interviews in this study were primarily done to find the current barriers and requirements needed to conduct distance education on a larger scale. The research began with defining the Department Chairmen's concerns with distance education at NPS. Each recommendation, developed from the concerns, is supported by interviews with Department Chairmen, Educators, and Administrators, as well as literary findings. Implementation requirements and benefits to both the DoN and NPS are also provided for each recommendation.

The first recommendation this thesis supports is for NPS to develop a mission and vision statement for distance education. The second is to establish a NPS Distance Education Support Center to centralize campus efforts in distance education. The third recommendation is to institute a NPS Distance Education Marketing Plan to find potential customers and increase distance education interest on campus. The fourth recommendation is for NPS to immediately determine the cost for distance education in order to request additional funding from DoN. Finally, the study recommends NPS begin a pilot program as a model for future distance education for active duty officers in the fleet. The proposed pilot program presented in this study is with HSL-41, a LAMPS Mark-III Squadron. With these recommendations, this thesis looks to make NPS the "Navy's Distance Education University." This study concludes with a timeline for implementing these recommendations.

A PROPOSED ARCHITECTURE FOR ON-LINE JDISS TRAINING

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The Joint Deployable Intelligence Support System (JDISS) is the primary Department of Defense system for the exchange of intelligence information. Unfortunately, the system lacks an adequate computer learning application. The widespread implementation of universally connected client/server networks, such as JDISS, will soon be enhanced by advanced World Wide Web (the Web) services. The combination of the Web and object-oriented technology, known as distributed object technology, may provide a solution to this problem. Use of the Common Object Request Brokerage Architecture (CORBA) Object Request Broker (ORB) could allow users of the (JDISS) to create customized training modules on-line the distributed object environment. Until JDISS adopts an ORB standard, an intermediary on-line training system based on advanced HTML, Java applets, and JavaScript could provide some of the functionality expected of an ORB based system. Regardless of the technology used to develop on-line JDISS training, certain system requirements must be met by any system to ensure its success. These requirements are defined from both the user and system administrator perspectives.

USING EXPERT SYSTEMS TO CONDUCT VULNERABILITY ASSESSMENTS

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An Information Warrior faces a complex and dynamic operating environment. To conduct an accurate Vulnerability Assessment and Risk Analysis of the enemy force (or a friendly force), a multitude of cause and effect relationships must be examined. Many times the person at the battle scene conducting the assessment may lack experience and/or knowledge, precluding a time-sensitive and effective assessment. The author proposes a framework for a global network of expert systems and decision support systems to conduct the Vulnerability Assessments and maintain Information Warfare readiness through realistic training. The author also presents a Vulnerability Assessment and Risk Analysis heuristic with the objective of expanding the knowledge base and decision speed at the on-scene commander level. In achieving and implementing this global network, numerous benefits can be realized, including increased speed and efficiency in the receipt of intelligence information, thereby allowing for improved decision-making capabilities. Since the technology and know-how are already available, this vision of the global network is attainable and can be successfully implemented and operated.

MK 92 MOD 2 FIRE CONTROL SYSTEM MAINTENANCE ADVISOR EXPERT SYSTEM: IMPLEMENTATION AND DEPLOYMENT

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This thesis perpetuates research aimed at deploying a diagnostic expert system for the MK 92 Mod 2 Fire Control System to 28 Oliver Hazard Perry class fast frigates. Referred to as the Maintenance Advisor Expert System (MAES), this expert system is being jointly developed by the Naval Postgraduate School and Port Hueneme Division, Naval Surface Warfare Center (NSWC PHD).

This thesis focuses on the long-term implementation issues related to deploying MAES to the fleet, integrating MAES into the formal training pipeline, and transitioning life cycle support for MAES to NSWC PHD. MAES long-term implementation issues, which include hardware, software, documentation, and training requirements, are examined within the context of implementation factors and risks historically associated with deploying expert systems.

Plans for deploying MAES to the fleet and integrating MAES into the formal training pipeline are provided. As part of the documentation necessary to transition life cycle support of MAES to NSWC, a System Level Description document is also provided.

EXPERT SYSTEMS DEVELOPMENT UTILIZING HEURISTIC METHODS

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This thesis analyzes the diagnostic domain and isolates the heuristics employed by experts to arrive at diagnostic solutions. These heuristic methods are then generalized in order to arrive at a series of heuristic rules that can be applied to a wide range of diagnostic processes independent of their respective domain. To test the validity of the generalized

heuristics, a prototype expert system was created targeting the heuristics employed by avionics repair technicians in repair of the APS-115 radar system on the P-3C Orion.

USING CLIENT-SERVER APPROACH TO DESIGN A GENERIC LOCAL AREA NETWORK (LAN) FOR NAVAL ACADEMY OF REPUBLIC OF CHINA (ROCNA)

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This thesis demonstrates the application of design theory as it relates to the generic LAN for the Naval Academy of the Republic of China (ROCNA). The first part of the study covers a theory dealing with system analysis and design, network technology and data communication. This is used for a foundation for the development of a end-user survey and feasibility study for the ROCNA LAN. Chapter III of this study is a background of the ROCNA and an analysis of the Naval Academy's network requirements. In Chapter IV a generic LAN is developed to meet the ROCNA's requirements and different alternative designs are investigated. A cost-benefit analysis is performed to select between the design alternatives.

The design selected uses a point-to-point connection dual ring backbone and a 10BaseT star topology for subnetworks. Finally, recommendations and conclusions are presented in Chapter V for more emphasis on information technology education in the Republic of China's Armed Forces and specifically at the ROCNA.

ENSURING A C2 LEVEL OF TRUST AND INTEROPERABILITY IN A NETWORKED WINDOWS NT ENVIRONMENT

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With the progression of computer systems to local and wide area networks, the scope of computer security has increased dramatically over the past two decades. Now, more than ever, the use of "trusted systems" is needed to ensure the secrecy, integrity, and availability of computer resources. However, attaining the levels of trust required has been difficult for a variety of reasons. This paper provides an in-depth look at the government's Trusted Computer System Evaluation Criteria (TCSEC) and its current applicability. An analysis of a military network running Windows NT version 3.51 as the network operating system is provided as a case study. The paper concludes with a discussion of the advantages and disadvantages of the TCSEC criterion. Although products have been certified as meeting the various class requirements, existing problems are preventing the attainment of "trusted" system from becoming a reality for many government organizations.

SURVEY OF USER AUTHENTICATION MECHANISMS

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The use of a password as the only traditional user authentication mechanism has been criticized for its weakness in computer security. One problem is for the user to select short, easy to remember passwords. Another problem is the selection of a password that is too long which the user tends to forget. Long passwords tend to be written down carelessly somewhere in the work space. Such practices can create serious security loopholes.

Consequently, this is a survey of alternative password mechanisms and other improved devices that are now available in the marketplace to enhance computer security. It taxonomizes the existing inventory of user authentication mechanisms such as biometrics, challenge/response, password, smart card and token.

DECISION SUPPORT FOR NETWORK CONNECTIVITY PLANNING

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The aim of this thesis is to design and implement a highly-graphical, computer based decision support system (DSS) to assist in the design of "optimum" network connectivity plans. The *Web Spinner* DSS is a "proof-of-concept" system which highlights how the marriage of basic decision methodologies with a modern computing environment can be used to create a robust decision support tool.

The basic concepts of decision support systems and their practical value to today's information worker are discussed. The challenge in designing the best network plan is presented along with several examples illustrating the complexities and scale of the problem. The *Web Spinner* DSS is presented as a potential solution to at least part of the network design problem. The capabilities and design principles of the *Web Spinner* are provided along with a tutorial and a sample problem. Finally, some suggestions for improving the *Web Spinner* DSS are reviewed. It is shown that some of these improvements can greatly enhance the value of the *Web Spinner* in supporting decisions related to network connectivity.

DESIGN AND IMPLEMENTATION OF A PROTOTYPE DATABASE SYSTEM FOR THE OPERATIONAL ACTIVITY SCHEDULE OF THE HELLENIC NAVY

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The Hellenic Navy General Staff has a difficult mission which encompasses several tactical, operational, and administrative tasks. The most important operational task for the General Staff is to prepare the Operational Activity Schedule for every ship, subcommand, and command in the Hellenic Navy. In order to more effectively prepare this schedule, an automated database system is required. This system would contain all operational activity records for the Hellenic Navy units and other pertinent information. Furthermore, the system would produce ad hoc reports, as well as a variety of other reports designed by the user to support ship maintenance schedule.

This thesis designs and implements an automated database system that can be used from the Hellenic Navy General Staff. The methodology followed is the standard systems' development life cycle (SDLC). The requirements for

the system are obtained, and the database and application are designed and implemented. Paradox 5.0 for Windows is used for the database management system software. Special issues like training, security, conversion, and maintenance are taken into consideration.

The result of this thesis is a functional application named "OADS" (Operational Activity Database System) that will fulfill users' requirements, keep track of the operational activities of the Hellenic Navy units, and help in performing the desired tasks accurately.

ANALYSIS OF STANDARDIZED BAR CODING AND THE USER/BUYER ELECTRONIC CATALOG'S POTENTIAL FOR EFFECTIVE CHANGE WITHIN THE DEPARTMENT OF DEFENSE

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The Department of Defense has been relying on business practices and material management methods that date back to the 1940's and before. Once the premier innovator in the field of logistics, the DoD has fallen woefully behind commercial businesses in the past few decades. Advances in Electronic Commerce/Electronic Data Interchange (EC/EDI) technology have far out paced the DoD's ability to keep up. Challenged by President Clinton in 1994 to reinvent government and to modernize and streamline business practices, the DoD has since been studying applications of EC/EDI that will allow them to integrate successful logistics ideas into DoD operations. This thesis examines an exciting application of EC/EDI currently under review, the Electronic Catalog, and its potential impact as a catalyst for change within the DoD. Reviewing 3M Corporations operational CONNECTSUS User/Buyer Electronic Catalog system against proposed Defense Logistics Agency initiatives, this thesis looks at the benefits to be gained by the DoD. Integral to the thesis is a review of standardized bar coding and how it fits into, and enhances, EC/EDI.

INTERNETWORKING: EXTENDING LOCAL-AREA NETWORK (LAN) CONNECTIVITY USING ISDN

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Internetworking is the ability to seamlessly interconnect multiple dissimilar networks globally using the Internet (Brutzman, 96). In order to achieve this network, data links need to provide data speeds which allow the applications to function properly. Many important networked applications require high bandwidth to perform effectively.

This thesis presents an analysis of Basic Rate Interface (BRI) Integrated Services Digital Network (ISDN) as a data link technology for extending Local Area Network (LAN) connectivity. Hardware and software capabilities are presented in detail. A representative "ISDN user needs analysis" is also provided. A study is made of an ISDN installation and implementation to determine if ISDN is a viable solution to extending LAN connectivity.

Considerations of particular importance include Internet Protocol (IP) compatibility, bonding separate channels to act as a single 128 Kbps logical channel, and native support for IP multicast addressing. Experimental results indicate that ISDN meets most essential requirements.

INTRANETS

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and
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The purpose of this thesis is to develop a prototype Client-Server application that can be used by selected Naval Postgraduate School staff-members to coordinate meeting agendas and travel plans. A prototype application that can be implemented and deployed on an organizational network was designed and developed using commercially available tools. The thesis also addresses the current computing problems confronting this institution and the reasons why corporate America is embracing Web-based intranet technology; it will also examine why a Web-based intranet is a viable solution for many of the computing problems facing this organization. Additionally, we examined other applications that can be developed and deployed on an intranet at the Naval Postgraduate School. Finally, we explore the renowned intranet at Sandia National laboratories and explain which factors played the most significant role in the success they have achieved with intranet technology at their organization.

THEATER BALLISTIC MISSILE DEFENSE: MODELING AND ANALYSIS OF THE MARINE CORPS "HAWK" MISSILE DEFENSE SYSTEM

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This thesis develops the concept of integrating IDEF modeling with matrix analysis to explore the current state of the Marine Corps, "As Is", Theater Ballistic Missile Defense information architecture. It demonstrates the possibility of using matrix analysis in conjunction with IDEF modeling to identify deficiencies within an existing information architecture. Using this framework, new technologies and advancements can also be measured to ensure they accurately address deficiencies identified in the analysis. Additionally, this thesis incorporates the knowledge garnered from this analysis into a possible, "To Be", physical architecture for the year 2002. It examines the "As Is" physical architecture, technological advances, and environment enhancements, and proposes one possible infrastructure for future theater missile defense.

Models have traditionally been developed as analysis vehicles which conform only to administrative processes. This led to minimal utilization of the application and its capabilities. Matrix analysis allows for accurate investigation and documentation of information and systems useful in the development of new technologies. This thesis demonstrates that modeling, combined with matrix analysis can also be incorporated for tactical processes.

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

AUTOMATED MESSAGING FOR THE GLOBAL COMMAND AND CONTROL SYSTEM: ANALYSIS OF UPGRADING COMMUNICATIONS IN THE NPS SECURE SYSTEMS TECHNOLOGY LABORATORY (SSTL)

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The Global Command and Control System (GCCS) is currently operational in the Secure Systems Technology Laboratory located in Root Hall at the Naval Postgraduate School. All subsystems of GCCS are operational with the exception of the Automated Message Handling System (AMHS). The SSTL's efforts to obtain an operational GCCS AMHS depends on the future availability of the Automated Defense Information Network (AUTODIN), and the emerging technology of the Defense Message System (DMS). This thesis examines and compares GCCS AMHS and DMS and the implementation requirements for each. This thesis draws the conclusion that DMS is the dominant system over GCCS AMHS and continues to examine the acquisition strategies and costs required to implement the DMS in the SSTL.

THE DIGITAL LIBRARY PHENOMENON: OPPORTUNITIES AND IMPLICATIONS FOR THE NAVAL SERVICE

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This thesis examines the emerging field of work encompassed by the term "Digital Library," and offers a plan for developing a Naval Service Digital Library. The amount of data and processing capabilities, available via networking technology, already defies description and continues to grow daily. As access to electronic resources and their diversity increase, a void in electronic Information Management principles and technologies has been uncovered. Participants in the global Digital Library (DL) movement are striving to adapt the principles of Library Science from locally controlled and accessed resources (books, magazines, videos, etc.) to remotely-shared electronic media and data processing systems. This thesis specifically addresses the movement's background, current initiatives and technologies (circa 1996).

The Naval Service can benefit immediately from monitoring and exploiting the DL technologies being developed world-wide. There are tremendous economies to be reaped in meeting our non-tactical, day-to-day information needs. To date, Navy and Marine Corps DL-related projects are narrowly focused by organization and limited to tactical, engineering and research information needs. By consolidating these efforts with a unifying vision and cooperative intent, a Naval Service Digital Library (NSDL) can be constructed. The NSDL would benefit all service members, in both their professional and personal lives, by providing a gateway to millions of resources that are compatible, searchable and ready for use. This thesis recommends an organizational structure and management strategy for developing a Naval Service Digital Library.

NETWORKING REQUIREMENTS ANALYSIS FOR ENGINEERING 2000

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The Cruise Weapons community wants to evaluate its baseline network and define the characteristics of its Engineering 2000 target network. In this thesis, we develop and execute a methodology for completing these actions. By following this methodology, we compare the community's current requirements with its current capabilities to produce our baseline evaluation. Then, we predict the future requirements and capabilities. From this, we produce our target definition. In our baseline evaluation, we find that the current network does not provide sufficient reach, range, responsiveness, user support, or workgroup support. In addition, we find that it is too complex to maintain or manage effectively. In our target definition, we determine that the future network should be a simple, centrally managed and maintained system that supports all users, including afloat customers and mobile employees. Furthermore, we determine that the network should handle simple messages, multi-version documents, and engineering drawings. In order to provide these capabilities, we recommend that the community streamline its applications suite, discard unnecessary computing assets, produce formal maintenance and management policies, and establish a network operations center. In addition, we recommend that the community implement peer-to-peer networking systems within workgroups, take advantage of upgrading LAN technology at the local level, and continue working with DoD service providers for wide area communications.

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FINANCIAL TRANSACTION MECHANISMS FOR WORLD WIDE WEB APPLICATIONS

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The World Wide Web is the fastest growing application of the Internet. Its continual growth has provided a new electronic medium for commerce. One of the more exciting uses of the World Wide Web in commerce is the selling of information, instead of goods. A major obstacle that the World Wide Web in general and information sellers specifically face for commercialization is secure means in conducting financial transactions. This thesis' objective is to develop a criteria for individuals to use in the evaluation of the different financial transaction mechanisms that are becoming available on the World Wide Web.

Two of the leading financial transaction mechanisms available today, First Virtual and Netbill are analyzed in detail and compared on the basis of these criteria. This analysis is then applied to Decision Net. While First Virtual's is further along in the development process, Netbill promises to offer better features to the meet Decision Net's requirements.

A DATABASE APPROACH TO MAINTAINING THE INFORMATION TECHNOLOGY MANAGEMENT GROUP FACULTY RESEARCH CATALOG ON THE WORLD WIDE WEB

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This thesis documents the development of an on-line information technology management (ITM) research catalog that can be accessed by DoD and DoN agencies or other interested parties via the World Wide Web. The on-line research catalog allows the ITM professors at the Naval Postgraduate School (NPS) to quickly and easily maintain their own research information regardless of their operating platform.

The logic for a multi-user relational database approach to managing the research catalog is addressed. A semantic object model and a relational diagram are developed to create a conceptual design for the database. Next, the application process and description of the common gateway interface (CGI) scripts are presented. Chapter four displays and discusses the catalog's major user interfaces. Finally, this thesis concludes with a plan for using the system and recommendations for further improvements.

SOLUTIONS FOR RELIABLE MULTICASTING

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Many of the applications that will be hosted on the Marine Corps' Tactical Data Network (TDN) require data to be delivered reliably from one sender to many receivers. Reliable multicast protocols are better suited for this one-to-many communication than conventional transport layer unicast protocols. These multicast protocols will have to contend with the limited bandwidth and high bit error rates of wide area links in the tactical internet. They must also adapt to the internet's changing topology, and be robust enough to survive its inevitable disruptions.

This thesis evaluates several reliable transport layer multicast protocols for their ability to deliver data reliably over a tactical Internet. Because multicast routing protocols build delivery trees for these protocols, they are also evaluated.

The bandwidth saved by multicast protocols make them particularly valuable in the tactical internet. However, at both the network and transport layers, no single protocol satisfies all the requirements of the internet. Which protocols are selected for TDN depends on how the decision maker weighs the requirements of the tactical internet. The types of tactical data systems will also influence the choice of a multicast routing protocol. Similarly, the reliable multicast protocols which are selected must meet the demands of the application for which they were designed while still operating within the constraints imposed by the tactical internet.

IMPLEMENTING A DECISION SUPPORT SYSTEM ON THE WORLD WIDE WEB

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As the popularity and use of the World Wide Web (the Web) increases daily, many technologies and applications that were initially developed and used as stand alone tools are migrating towards the Web. Decision support technologies are examples of applications that traditionally have been developed as stand alone systems. One feature common to all decision support systems is that they require user input to produce results. However, due to some inherent limitations with the Web, some modifications must be made to allow users to interact with these technologies. Common Gateway Interface (CGI) programs, or scripts, provide Web servers the capability to produce dynamic documents and maintain user information or state. With CGI scripts, developers can capture user entered data, access external applications to process the data, and return the results. Using CGI scripts to interface with database applications gives Web servers the ability to maintain state by tracking user data, information, and preferences. This thesis implements a Windows spreadsheet based decision support system (DSS) designed to optimize radar coverage of tactical aircraft. Using Delphi to write CGI scripts, the Web based DSS allows the user to enter data to run a new problem, save input and output data, and retrieve the saved data at a later time.

NETWORKING REQUIREMENTS ANALYSIS FOR ENGINEERING 2000

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and
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upgrading LAN technology at the local level, and continue working with DoD service providers for wide area communications.

ANALYSIS AND DESIGN OF AN INFORMATION SYSTEMS NETWORK IN THE FORMER SOVIET UNION

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In an effort to facilitate democratic reforms in the Former Soviet Union (FSU), the President of the United States authorized the establishment of American Business Centers (ABCs) through the Freedom Support Act of 1992. The Act promotes U.S. economic interests by establishing commercial partnerships between the United States and the FSU. Integral to this transition is the role of information technology. The purpose of this thesis is to assist the ABCs in defining their information system needs by producing a network model that takes into account the unique operating environment within the FSU. The essential elements of this model are range, reach, and responsiveness. They characterize the utility of an information system to an organization. The model is applied to the ABCs to form a baseline assessment that provides a point of reference from which a target architecture can be formulated. It is this target architecture that is intended to serve as a baseline configuration for local/wide area enterprise networks to be used by the ABCs within the FSU. The thesis concludes with a discussion of those drivers that could significantly affect the viability of the American Business Centers.

AN IMPLEMENTATION OF TRACEABILITY MODELS

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The DoD is concerned with ensuring that the designed systems meet the specified requirements. Current standards governing the procurement of complex computer based systems (e.g., DoD-STD-498) state that requirements traceability must be accomplished, without providing more elaboration on what information must be captured and how it is to be used. Based on a detailed study of traceability practice in several organizations engaged in system engineering, recent research at Naval Postgraduate School (NPS) has developed several models of traceability. These models identify the components of a comprehensive traceability scheme to capture various stakeholders' views. Our research investigates how the NPS models can be used in a complex system engineering project. An example problem developed by the Naval Surface Warfare Center (NSWC) based on the 21st Century Ship was used for implementing these models. SLATE, a commercial CASE tool with sophisticated requirements traceability functionalities was used. We illustrate traceability between mission needs, system objectives, requirements, design and implementation. Requirements identification, representation of rationale and assumptions, and ad-hoc queries are also discussed. The models used were effective in capturing traceability information in this complex system engineering problem.

INDEXING AND RETRIEVAL IN DIGITAL LIBRARIES: DEVELOPING TAXONOMIES FOR A REPOSITORY OF DECISION TECHNOLOGIES

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DecisionNet is an online Internet-based repository of decision technologies. It links remote users with these technologies and provides a directory service to enable search and selection of suitable technologies. The ability to retrieve relevant objects through search mechanisms is basic to any repository's success and usability and depends on effective classification of the decision technologies. This thesis develops classification methods to enable indexing of the DecisionNet repository.

Existing taxonomies for software and other online repositories are examined. Criteria and principles for a good taxonomy are established and systematically applied to develop DecisionNet taxonomies. A database design is developed to store the taxonomies and to classify the technologies in the repository. User interface issues for navigation of a hierarchical classification system are discussed. A user interface for remote World Wide Web users is developed. This user interface is designed for browsing the taxonomy structure and creating search parameters online. Recommendations for the implementation of a repository search mechanism are given.

SURVIVABILITY OF FREE INFORMATION RESOURCES ON THE WEB

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Economists rightly believe that people rarely give away valuable resources. Yet a casual look at the World Wide Web suggests otherwise. This thesis shows that the economists are right: firms and organizations, even on the World Wide Web, rarely give away valuable information. Instead, the Web sites are "advertising sites". Just as "free TV" is based on paid advertising, apparently free access to Web sites is really access to advertising. This conclusion is based on a statistical analysis of 58 Web sites. The sites were chosen using the snowball relational sampling technique, whereby one Web site leads logically to others. Five percent of the sampled sites were closed during the period of study. Hypothesis testing using the variables category, product, motive, revenue base, charges, and documentation permit the conclusion that the remaining 95 percent are likely to be maintained by their hosts and sponsors. This is comforting news for DoD users of informational services on the Web. DoD users are likely to have access to such services in the future.

AN EXPERIMENTAL INVESTIGATION OF THE INTERACTION BETWEEN FEEDBACK AND GOALS ON STAFF RESOURCE ALLOCATION

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The Department of Defense Information Technology budget stands at nine billion dollars and is under severe scrutiny while the backlog of required software continues to grow. It is thereby necessary to improve the efficiency of managing the software process. This thesis uses the Systems Dynamic Model of Software Project Management to investigate the effects of stated goals and project feedback on project manager behavior. Specifically, the experiment focuses on how software project managers allocate resources in both factual and erroneous feedback environments. The effect of goals and feedback on manager performance are measured in terms of staffing level decisions, percent of staff allocated to

quality assurance activities, estimated schedule, estimated programmer productivity, and estimated cost. The results show that manager performance is highly sensitive to stated goals.

AN IMPLEMENTATION OF TRACEABILITY MODELS

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FEASIBILITY COMPARISON AND ANALYSIS OF THE UNIX NETWORK ENVIRONMENT AND THE WINDOWS NT ENVIRONMENT FOR INTEGRATION WITH THE DEFENSE INFORMATION INFRASTRUCTURE (DII)

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The history of the Department of Defense (DoD) information system technical infrastructure includes a collection of stovepipe, single purpose systems. Recently, the DoD has developed initiatives to help promote the development of

common target architectures to which DoD information systems can migrate, evolve, and interoperate. The DoD's Technical Architecture Framework for Information Managers (TAFIM) provides system developers guidance and methodologies for developing standard architectures. The Defense Information Infrastructure (DII) Common Operating Environment (COE) is a development architecture based on the ideas of TAFIM, and provides a framework for designing and building military information systems.

This thesis applies the objectives presented in TAFIM in order to develop an approach for determining which network operating system (NOS) would best facilitate implementations of the DII COE. By first examining the evolution of Navy information systems, and the development of the DII COE, this thesis provides a detailed description of requirements placed on a NOS by a DoD DII COE based information system. These requirements are then used to help understand how TAFIM's objectives apply to NOSs. Two prevalent NOSs, Unix and Windows NT, are evaluated structured on TAFIM's guidance and the requirements of the DII COE. A determination is made based on these guidelines that both NOSs belong in future information systems, for appropriate tasks, based on the DII COE.

RE-ENGINEERING A COMPUTER-BASED TRAINER FOR A HELICOPTER NIGHT VISION SYSTEM

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While there have been unfavorable responses to Department of Defense "right-sizing" efforts, this force restructuring has actually produced certain positive results. Capitalizing on technological advances, the aviation community, in particular, has adapted to personnel cuts and reduced budgets without sacrificing the quality of training. As a result, considerable emphasis is currently placed on computer-based training (CBT) applications. The development of this type of training for critical, high-risk, missions, such as those involving scarce night vision equipment, has encouraged numerous research projects including this thesis.

Sponsored by Naval Air Systems Command (PMA-205), this thesis discusses methods used to re-engineer the UH-1N helicopter Aviator's Night Vision Imaging System/Heads-Up Display (ANVIS/HUD) CBT for use in the HH-60H community. By using portions of code, graphics, and text originally designed for the UH-IN CBT, the HH-60H version was developed through a revision process which incorporated new material as required.

The final product is a trainer consisting of five instructional modules, combining student evaluation and remediation features through interactive lessons and exercises. In accordance with current design principles, an object-oriented authoring system enabled the production of a quality CBT that meets the sponsor's budget and time constraints, and promises to be a key training asset for HH-60H personnel.

FEASIBILITY COMPARISON AND ANALYSIS OF THE UNIX NETWORK ENVIRONMENT AND THE WINDOWS NT ENVIRONMENT FOR INTEGRATION WITH THE DEFENSE INFORMATION INFRASTRUCTURE (DII)

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The history of the Department of Defense (DoD) information system technical infrastructure includes a collection of stovepipe, single purpose systems. Recently, the DoD has developed initiatives to help promote the development of common target architectures to which DoD information systems can migrate, evolve, and interoperate. The DoD's Technical Architecture Framework for Information Managers (TAFIM) provides system developers guidance and methodologies for developing standard architectures. The Defense Information Infrastructure (DII) Common Operating Environment (COE) is a development architecture based on the ideas of TAFIM, and provides a framework for designing and building military information systems.

This thesis applies the objectives presented in TAFIM in order to develop an approach for determining which network operating system (NOS) would best facilitate implementations of the DII COE. By first examining the evolution of Navy information systems, and the development of the DII COE, this thesis provides a detailed description of requirements placed on a NOS by a DoD DII COE based information system. These requirements are then used to help understand how TAFIM's objectives apply to NOSs. Two prevalent NOSs, Unix and Windows NT, are evaluated structured on TAFIM's guidance and the requirements of the DII COE. A determination is made based on these guidelines that both NOSs belong in future information systems, for appropriate tasks, based on the DII COE.

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

FEASIBILITY COMPARISON AND ANALYSIS OF THE UNIX NETWORK ENVIRONMENT AND THE WINDOWS NT ENVIRONMENT FOR INTEGRATION WITH THE DEFENSE INFORMATION INFRASTRUCTURE (DII)

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DEVELOPMENT OF A GRAPHICAL USER INTERFACE FOR REMAP

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A consistent and simple graphical user-interface (GUI) is an important factor contributing to the success of interactive systems. Developing such a GUI for complex applications is an important aspect of software development within DoD. This thesis investigates the complexities of developing a GUI using high-level, object-oriented frameworks. A usability study identified several problems with the user interface of REMAP, a system for capturing design rationale in a formal systems development environment. Based on the recommendations from this study, several improvements were made to the GUI of REMAP. These include changes to the layout to provide an enlarged graphical area, development of context sensitive pop-up menus, a simplified set of controls, keyboard shortcuts for frequently used commands and a more detailed information window. Implementation strategies to achieve the desired functionality are the use of high

level object oriented frameworks, use of design patterns, simplification of object hierarchies, and improved pointer functionality. Detailed examples on the use of these strategies are provided with software code and screen images from the application.

INTERNETWORKING: ECONOMICAL STORAGE AND RETRIEVAL OF DIGITAL AUDIO AND VIDEO FOR DISTANCE LEARNING

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Previous research has shown that it is possible to use the Internet's Multicast Backbone (MBone) and associated audio/video software for the purpose of Distance Learning. As more education is performed online, the need arises to be able to view the content at the user's convenience. Through experimental testing, this thesis investigates the usefulness and feasibility of applying networked recording and storage of digitized audio and video, all via the MBone for distance learning.

Large, distributed organizations such as the Naval Service can economically benefit from use of the MBone and its associated tools. To date, Navy and Marine Corps projects using video teleconferencing have not exploited the vast possibilities provided by the Internet and the MBone. This thesis takes distance learning one step farther and combines MBone audio/video with the new recording tool called the Multicast Backbone Video Conference Recorder (MBone VCR). This enables distance learning as a viable replacement to on-site training. It is technically feasible and economically supportable to record the digital media that results from an MBone session used for a distance learning program. That stored information can then be used repeatedly and easily updated to support changing curricula and information. Problems and network-accessible solutions are demonstrated in this case study on use of the MBone VCR as a usable remote educational tool.

ADAPTIVE INFORMATION SYSTEMS: PORTALS TO EMPLOYMENT, TARGETING THE PHYSICALLY AND MENTALLY CHALLENGED

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Steven Lamar, Institute for Defense Education and Analysis

This thesis assesses and provides a critical evaluation of reasonable accommodations in the telecommunications and information systems technologies for people with disabilities at the Naval Postgraduate School. The Americans with Disabilities Act of 1990 established a clear and comprehensive prohibition of discrimination on the basis of disability. As barriers to access are removed, more people with disabilities are taking their rightful places as contributing members of society.

This research has provided an assessment of the Naval Postgraduate School's compliance with the spirit of the Americans with Disabilities Act in providing reasonable accommodations. Areas where information systems and telecommunications products and services are not fully accessible by faculty, staff, or student with a disability were identified.

This research provided recommendations to assist NPS faculty, staff, and managers of Automated Information Systems provide Assistive Technologies Support Services and Devices. Outside resources were identified that can assist the Naval Postgraduate School by providing the expertise, education, and training on the issues dealing with reasonable accommodations in the workplace. The lessons learned are applicable to all Department of Defense activities.

ANALYSIS OF NETWORK TRAFFIC AND BANDWIDTH CAPACITY: LOAD BALANCING AND RIGHTSIZING OF WIDE AREA NETWORK LINKS

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The purpose of this thesis is to provide a process model to assist organizations in analyzing their Wide Area Network communication lines. The Naval Medical Information Management Center (NMIMC), in Bethesda, Maryland, is used as the model site, due to its imminent deployment of World Wide Web (WWW) servers to Navy Medical Treatment Facilities (MTF's). To model the typical MTF, an analysis of the data traffic transmitted from the existing WAN links managed and monitored by NMIMC will be performed. These WAN links are critical for the delivery of health care related information transmitted between MTF's. The WAN links must be analyzed to ensure that adequate bandwidth is available to allow unobstructed traffic flow between destinations. The data traffic will be plotted to illustrate problematic conditions caused by high utilization rates. Corrective actions will be recommended that should help to reduce or eliminate the bottlenecks and increase operational availability. The hypothesis is that the WWW servers should be installed after the WAN links are analyzed and either balanced or properly sized. The load balancing and rightsizing of the WAN links will ensure that adequate bandwidth is available for the proper and timely transmission and access of vital WWW server information.

USING GENETIC PROGRAMMING AND STATISTICAL DATA ANALYSIS APPLICATIONS FOR KNOWLEDGE DISCOVERY IN MANPOWER DATABASES

Danny E. Turner-Lieutenant, United States Navy
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The Department of Defense (DoD) has significant interest in understanding the factors that contribute to the retention and attrition of its members. Statistical analyses of manpower and personnel data are conducted to predict the likelihood of members remaining in the service to complete their obligations or the likelihood of their separating early. Such quantitative studies can be complemented by approaches to discover potentially useful qualitative information to support decision/policy making.

Research in knowledge discovery or data mining has demonstrated the effectiveness of Artificial Intelligence (AI) techniques in eliciting such qualitative information through recognition of patterns or inference of "business rules" from data. Such knowledge discovery techniques may provide DoD with previously unobtained insights in the selection, management, and retention of its military personnel. Genetic programs, which are based on Darwinian evolutionary theory, can be used for knowledge discovery.

This thesis uses genetic programming and statistical data analysis applications for knowledge discovery in a DoD manpower database. This endeavor primarily focuses on evaluating the validity, redundancy, and significance of knowledge discovered.

PROMOTING DISTANCE EDUCATION AT NAVAL POSTGRADUATE SCHOOL (NPS)

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and
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This thesis defines and supports five recommendations for Naval Postgraduate School (NPS) to promote its distance education program. The research and interviews in this study were primarily done to find the current barriers and requirements needed to conduct distance education on a larger scale. The research began with defining the Department Chairmen's concerns with distance education at NPS. Each recommendation, developed from the concerns, is supported by interviews with Department Chairmen, Educators, and Administrators, as well as literary findings. Implementation requirements and benefits to both the DoN and NPS are also provided for each recommendation.

The first recommendation this thesis supports is for NPS to develop a mission and vision statement for distance education. The second is to establish a NPS Distance Education Support Center to centralize campus efforts in distance education. The third recommendation is to institute a NPS Distance Education Marketing Plan to find potential customers and increase distance education interest on campus. The fourth recommendation is for NPS to immediately determine the cost for distance education in order to request additional funding from DoN. Finally, the study recommends NPS begin a pilot program as a model for future distance education for active duty officers in the fleet. The proposed pilot program presented in this study is with HSL-41, a LAMPS Mark-III Squadron. With these recommendations, this thesis looks to make NPS the "Navy's Distance Education University." This study concludes with a timeline for implementing these recommendations.

THE DIGITAL LIBRARY PHENOMENON: OPPORTUNITIES AND IMPLICATIONS FOR THE NAVAL SERVICE

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This thesis examines the emerging field of work encompassed by the term "Digital Library," and offers a plan for developing a Naval Service Digital Library. The amount of data and processing capabilities, available via networking technology, already defies description and continues to grow daily. As access to electronic resources and their diversity increase, a void in electronic Information Management principles and technologies has been uncovered. Participants in the global Digital Library (DL) movement are striving to adapt the principles of Library Science from locally controlled and accessed resources (books, magazines, videos, etc.) to remotely-shared electronic media and data processing systems. This thesis specifically addresses the movement's background, current initiatives and technologies (circa 1996).

The Naval Service can benefit immediately from monitoring and exploiting the DL technologies being developed world-wide. There are tremendous economies to be reaped in meeting our non-tactical, day-to-day information needs. To date, Navy and Marine Corps DL-related projects are narrowly focused by organization and limited to tactical, engineering and research information needs. By consolidating these efforts with a unifying vision and cooperative intent, a Naval Service Digital Library (NSDL) can be constructed. The NSDL would benefit all service members, in both their professional and personal lives, by providing a gateway to millions of resources that are compatible, searchable and ready for use. This thesis recommends an organizational structure and management strategy for developing a Naval Service Digital Library.

IMPLEMENTATION AND EVALUATION OF COMMERCIAL OFF-THE-SHELF (COTS) VOICE RECOGNITION SOFTWARE AS AN INPUT DEVICE IN A WINDOWS-TYPE ENVIRONMENT
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B.A., Virginia Military Institute, 1988
Master of Science in Information Technology Management-March 1996
Advisor: Monique P. Fargues, Department of Electrical and Computer Engineering

This thesis investigates the implementation and evaluation of commercial off-the-shelf (COTS) voice recognition as an input interface within a windows-type environment. The three software packages implemented and evaluated are DragonDictate For Windows, version 1.3, VoicePilot 2.0 (both manufactured by Dragon Systems, Inc.) and IN^3 Voice Command for SPARCstation version 2.2.2 by Command Corp. VoicePilot and DragonDictate are both installed on PCs running MS Windows 3.1, and IN^3 is installed on a SPARCstation running OpenWindows 3 and SunOS 4.1.3. Several applications are manipulated using voice recognition with these three software packages. The results of this study show that DragonDictate has the most flexibility and ease of use as an input device for a windows-type environment. It is also shown that as usage increases, DragonDictates recognition accuracy is able to be improved to above 98%. Other areas of future research are also suggested.

APPLICATION OF ATM TECHNOLOGY TO THE SYSTEMS MANAGEMENT DEPARTMENT COMPUTER LABORATORY NETWORK
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Master of Science in Information Technology Management-March 1996
Advisor: Norman F. Schneidewind, Department of Systems Management

Since the appearance of Local Area Networks (LANs), their use and bandwidth consumption have increased considerably. Users are now seeking new technologies to satisfy their bandwidth demand. Many consider ATM the solution to their needs. Though ATM is a fairly new networking technology, it has made several strides, and is now considered a viable technology that is applicable in a LAN environment. However, migrating from today's shared-medium LANs (Token-Ring and Ethernet) to an ATM LAN exposes an organization to difficulties, risks and costs. A well thought-out migration strategy reduces the impact of these factors while implementing ATM technology.

This study reviews ATM technology and its application in a LAN environment, evaluates the Systems Management Department Computer Lab LAN, redesigns the LAN using ATM technology, and develops an evolutionary strategy to implement the proposed ATM LAN.